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MBMS in UTRAN

1 Introduction

1.1 General

This document discusses the handling of Multimedia Broadcast/Multicast Service (MBMS) in the UTRAN.

In the Rel99/Rel4/Rel5 UTRAN, allmost all communication with the UE (User Equipment) is based on point-to-point (PTP) transmission: almost all transmission of user data by the UTRAN is towards a specific UE. The only limited support the Rel99/Rel4/ Rel5 UTRAN has for point-to-multipoint (PTM) transmission concerns the low-bitrate Cell Broadcast Services.

For the UTRAN, the main new functionality that needs to be realised for MBMS concerns high bitrate PTM transmission.

The main purpose of this document is to serve as background for the stage2 and stage 3 specification work in 3GPP. The stage 1 provided by SA1 can be found in the document 3GPP TS 22.146 "MBMS; Stage 1". SA2 started the work with the document 3GPP TR 23.846 "MBMS Architecture and Functional description" and now the stage 2 work is documented in a corresponding 3GPP Technical Specification. RAN2 is working on RAN requirements which are documented in the document 3GPP TR 22.992 "Multimedia Broadcast/Multicast Service (MBMS); UTRAN/GERAN requirements" and in the stage 3 specification 3GPP TS 25.348 "Introduction of Multimedia Broadcast/Multicast Service (MBMS) in RAN".

Chapter 2 discusses different MBMS transmission alternatives for the UTRAN on the UTRAN radio interface Uu.

Chapter 3 discusses up to what extend the CN needs to be aware of the transmission alternatives the UTRAN is using.

Chapter 4 presents a number of signalling flows, addressing the main scenarios that may occur.

Chapter 5 discusses possibilities with respect to product phasing when introducing MBMS in the Ericsson UTRAN.

Chapters 6 and 7 look at more detailed aspects of the Uu, Iu and Iur interface respectively.

Assumption 1.1: *There is no need to discern between multi-cast services and broadcast services in this document since the handling of both types of services is identical for the UTRAN.*

2 Uu MBMS Transmission alternatives

Different alternatives can be identified regarding how to realise transmission of an MBMS service in the UTRAN on the Uu interface:

1) PTP - only

2) PTM - Continuous transmission

3) PTM - Discontinuous transmission

4) PTP or PTM – Discontinuous transmission

Each of these alternatives is described in more detail in the next sections.

2.1 Alternative 1: PTP

In this alternative, those UEs that want to receive a certain MBMS service will receive the information via point-to-point radio links.

In the NAS-domain, the UE indicates it wants to receive a certain MBMS service. As a result, the CN establishes a normal RAB towards this specific UE which will carry the MBMS data.

Since only point-to-point transmission is used in this alternative there is no need to have the UTRAN aware that there are transmissions ongoing related to a broadcast/multicast service.

Therefore this alternative will not be discussed further in this document.

2.2 Alternative 2: PTM - Continuous transmission

In this alternative, Continuous PTM transmission of a certain MBMS service is configured in certain service areas (cells).

The PTM transmission is in this alternative is not dependant on e.g. the user load in the concerning cell.

This alternative is most suitable for MBMS service provisioning in areas where the likelyhood of a significant number of interested UEs is high.

2.3 Alternative 3: PTM - Discontinuous transmission

In this alternative, a certain MBMS service is always using PTM transmission.

However only if there is at least one UE in a cell interested in receiving the MBMS service, the PTM transmission will be turned on. If not a single UE in a cell is interested in a certain MBMS service, the concerning PTM transmission will be switched off.

Thus:

- If #(MBMSx interested UE's) == 0 => No MBMS transmission

- If #(MBMSx interested UE's) >0 => PTM MBMS transmission

This alternative can be seen as an intermediate step, taking away some of the disadvantages of alternative 2 (no transmission when no UE is receiving), but not providing the flexibility provided by alternative 4.

2.4 Alternative 4: PTP or PTM – Discontinuous transmission

In this alternative, a certain MBMS service will be provided based on PTP transmission if the number of UE's that wants to receive this MBMS service in a specific cell is low. Only when the number of receiving UE's in a certain cell exceeds a certain threshold $TR_{PTP<->PTM}$, the UTRAN will switch to PTM transmission in that cell[1].

This behaviour is reflected in the following expressions:

- If #(MBMSx interested UE's) == 0 => No MBMS transmission
- If $TR_{PTP<->PTM}$ > #(MBMSx interested UE's) >0 => PTP MBMS transmission
- If #(MBMSx interested UE's) >$TR_{PTP<->PTM}$ => PTM MBMS transmission

PTP transmission will always provide the most radio resource efficient transmission in case only 1 UE in a cell is interested in a certain MBMS service.

Using a sensible value for $TR_{PTP<->PTM}$, this alternative will provide the most radio resource efficient solution compared to the other alternatives listed here.

$TR_{PTP<->PTM}$ is assumed to have a typical value between 2 and 5.

3 Iu MBMS Transmission Modes

Next question is up to what extend the Core Network needs to be aware of the different MBMS transmission alternatives that were described in the previous chapter: Is the choice of transmission alternative a UTRAN internal issue related to smartness of UTRAN implementation, or is CN support needed for some of these alternatives ?

This question is important since it will directly impact the Iu interface between CN and UTRAN.

3.1 Background

For this question to be answered, it is important to distinguish between 2 roles an RNC can have in the UTRAN:

CRNC: Controlling RNC, the Radio Network Controller that controls the radio resources in a certain cell. The CRNC is also responsible for scheduling and control of the common channels on the Uu.

[1] The threshold for switching from PTP->PTM could be different from the threshold switching from PTM->PTP in order to prevent frequent switching between PTP and PTM transmission.

SRNC: Serving RNC, the RNC that controls the communication with a certain UE. The SRNC is responsible for scheduling and control of dedicated channels on the Uu.

Whenever for a certain UE the CRNC and SRNC are different, the CRNC and SRNC are interconnected via the Iur interface.

3.2 Tracking versus No-tracking

Assumption 3.1: *Point-to-multipoint transmission in RAN will be realised by using the FACH transport channel. Usage of the FACH transport channel is assumed to give a good compromise between R99-impact and radio efficiency.*

The FACH transport channel is a common channel for which (power) control and scheduling are completely handled by the CRNC.

Transmission alternative 2 assumed a continuous PTM transmission. The UTRAN does not need to be aware of how many UEs are interested in a specific MBMS service in the cell, or stated differently: the UTRAN does not need to track (=be aware of the cell the UE is in) users which want to receive a certain MBMS. As a result, no involvement of SRNC's is required.

This is different for alternatives 3 and 4. For these alternatives the UTRAN does need to be aware of the number of UE's that want to receive a certain MBMS service in a cell in order to switch on/off transmission (alternatives 3&4) or switch between PTP and PTM transmission (alternative 4). In these alternatives, the UTRAN needs to be able to track UE's receiving a certain MBMS service.

Assumption 3.2: *In those cases where it is necessary for the UTRAN to be aware of the number of users that want to receive a specific MBMS service, the counting by the UTRAN will be based on:*

- *UE-specific RAB's established towards these UEs, and*
- *Mobility monitoring based on Rel99 RRC connection related signalling.*

This approach is assumed to minimise UE&UTRAN impact while still resulting in acceptable performance.

Since it is the SRNC that handles the Iu signalling for a specific UE, and it is the SRNC that handles the RRC connection towards a specific UE, the CN needs to involve SRNC's in the MBMS handling for alternatives 3 and 4. Also CRNCs may be involved in this case since again the PTM transmission is handled by the CRNC.

Summarising the above, the CN needs to distinguish between 2 modes which are internally called MBMS Fixed- and MBMS Variable transmission modes:

MBMS Fixed transmission mode:

- CN only needs to inform CRNCs of the cells corresponding to a certain service area about a certain MBMS service;
- CN does not enable the UTRAN to track MBMS users;

- UTRAN is only able to use transmission alternative 2;

MBMS Variable transmission mode:

- CN needs to inform the SRNC of a UE that wants to receive a specific MBMS service;
- CN enables UTRAN to track MBMS users;
- UTRAN is able to use transmission alternatives 3 and 4.

The relation between the transmission modes and the transmission alternatives is shown in figure 1.

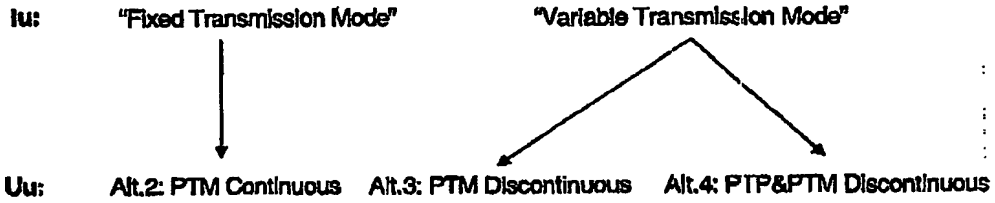

Figure 1: Iu Transmission Mode <-> Uu Transmission Alternative mapping

3.3 Uu: Idle Mode <-> Connected Mode

Since the tracking of a UE requires that UE to have an RRC connection, transmission alternatives 3 and 4 can only be used towards UEs in RRC Connected Mode. However since the UTRAN does not need to perform any UE tracking for alternative 2, in principle transmission alternative 2 can be supported towards UEs in RRC Idle Mode[2].

When the consequences of figure 1 were discussed both internally and externally (3GPP), it was considered unacceptable that usage of the variable transmission mode over Iu would rule out the support of UEs in RRC Idle mode. E.g. if the UTRAN detects certain areas in which there are always a sufficient number of UEs to justify PTM transmission, it should be possible for the UTRAN to use transmission alternative 2 in the concerning cells. UEs should be able to detect in a cell if an RRC connection is required for receiving a specific MBMS service, and take the corresponding action.

This results in an update of the mapping shown in figure 2:

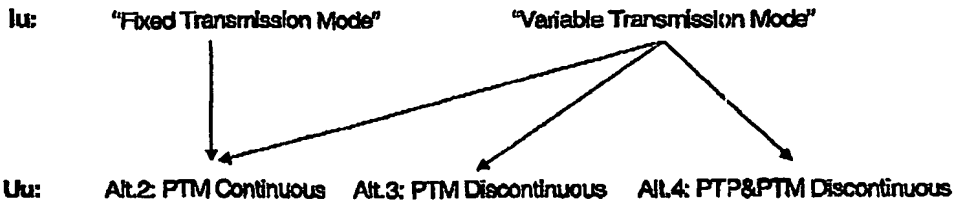

Figure 2: Updated Iu Transmission Mode <-> Transmission Alt. Mapping

[2] Assuming that we can define a solution on the Uu, which enables UEs in RRC Idle Mode to find and receive the MBMS transmissions (see chapter 5).

It is observed to be a problem to enable the CN to configure fixed PTM transmission in certain areas, which can be used by UE:s in idle-mode, and also still allow the UTRAN to optimise the radio signalling efficiency and choose for fixed PTM transmission in certain cells. A solution is that by combining the usage of the fixed Iu transmission mode and the Iu variable transmission mode for one MBMS service, the CN can configure PTM transmission in certain areas and still the UTRAN can decide to use a fixed PTM in certain other areas (see figure 2). As a result, both the CN and UTRAN can take decisions enabling reception in RRC idle-mode.

Note: Although it is assumed that the UTRAN does not need to differentiate between broadcast and multicast services (assumption 1.1), still it will be likely that an MBMS broadcast service will only use the "Fixed Transmission Mode" due to requirements related to availability for everybody without requiring any RRC connection. An MBMS multicast service could be mapped to either the Fixed transmission mode or the Variable transmission mode.

4 Example Signalling flows

In this chapter we look at several signalling flows related to MBMS service establishment and UE mobility.

4.1 MBMS Fixed Transmission Mode

4.1.1 Activation

The first example (figure 3) shows the simplest case in which the CN requests the UTRAN to provide a fixed transmission of a certain MBMS service in a fixed area.

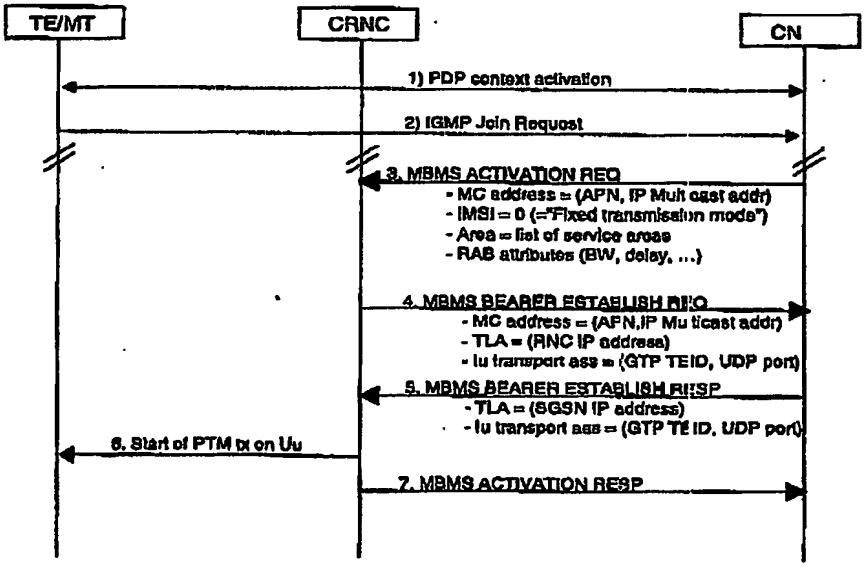

Figure 3: Fixed Transmission Mode Activation example

Remarks on the different steps:

Step 1&2: These steps are transparent for the UTRAN. They are only there in the case of an MBMS multicast service, not in the case of an MBMS broadcast service[3].

Step 3: When there is data to be transmitted the CN will initiate the MBMS ACTIVATION REQ. Note that this could be quite some time after specific UE's have sent an IGMP join in case there was a longer period without any data transmission.

Assumption 4.1: *Currently it is assumed that the combination of (APN, IP MC address) uniquely identifies a certain MBMS service. The APN (DNS name including operator and network identifier, 30-40 bytes) is required since different networks (different broadcast centres) may use the same IP MC address.*
Drawback of this identification is the size of both parameters which is quite large. It is still investigated if a shorter identity should be used.

Step 4: The RNC will immediately initiate the bearer establishment procedure if it did not receive the data already. The RNC can sent this message to any SGSN it knows. If no Iu-flex is configured, the RNC will only be aware of one SGSN. In case Iu-flex is configured, the RNC may know multiple SGSN. In this case the RNC can sent the message to any SGSN it knows, i.e. it is assumed that any SGSN the RNC knows is able to provide the data for any requested MBMS services.

Step 6: From Step6, it is assumed that the UE on its own will be able to detect the MBMS service transmission in the concerning cells. If the UE has joined the MBMS service and has received e.g. the correct keys, it will be able to receive the MBMS service without any further CN or UTRAN support. See chapter 6 for more details.

4.1.2 De-Activation

Figure 4 shows an example of the de-activation scenario for the fixed transmission case.

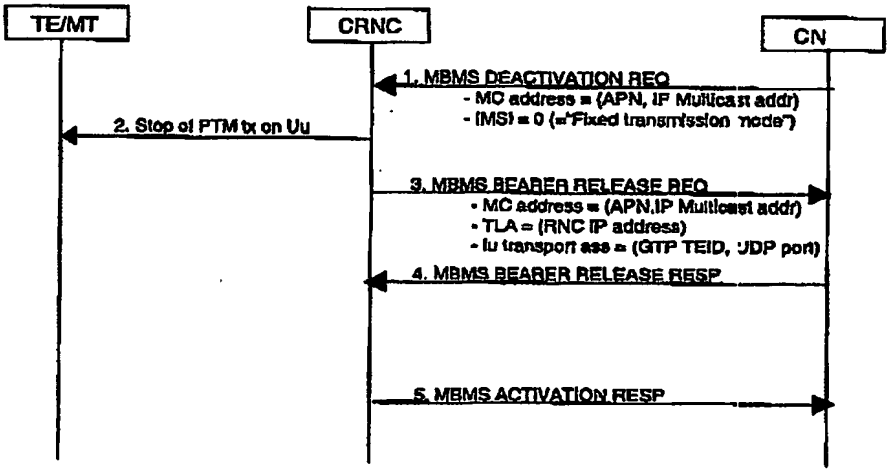

Figure 4: Fixed Transmission Mode De-Activation example

4.2 MBMS Variable Transmission Mode

4.2.1 MBMS Variable Transmission Mode - PTP example

The next signalling flow example shows the CN requesting an MBMS variable transmission mode:

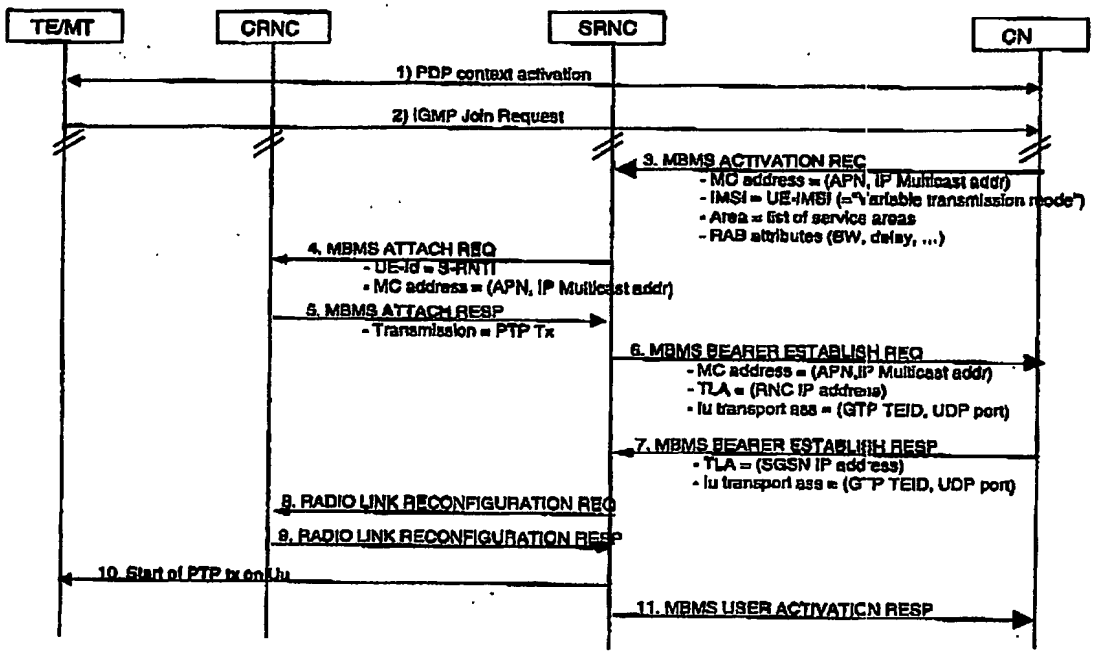

Figure 5: Variable Transmission Mode Activation PTP example

Remarks on the different steps:

Step 2: The IGMP Join Request has no confirmation at IGMP level, however will be confirmed with other NAS signalling (transparent to UTRAN).

Assumption 4.2: *For a certain MBMS service the CN will configure service areas where this service can be received or not. Then what to do when the UE performs the join in an area where the service will not be provided ? Or what to do when the UE performed the join in an area where the service will be provided, but then passes through an area where the service is not provided.*
Taking into account the location where the UE is located will make the handling of the IGMP join very complicated, e.g. in the mobility case (moving out and in an area where the service is provided), the UE could, e.g., perform a new IGMP join. The simplest way out of these problems is to assume that the handling of the IGMP join is decoupled from the fact if the UE is really in an area where it can receive the service or not. As a result, the UE might perform a succesfull IGMP join but still not get the service data. It is up to the

[3] An MBMS broadcast service is expected not to be ciphered. Therefore the UE does not need to receive any specific keys.

CN to configure the service areas such that this is an unlikely case. It needs to be further investigated if this approach is acceptable. There might also a relation to charging.

Step 4: Before establishing the user plane over Iu, the SRNC first checks if the CRNC wants to provide the MBMS-service based on a PTM transmission. In this example, the CRNC indicates that it does not want to provide PTM transmission for this MBMS service.

Step 6: Assuming the SRNC does not provide the requested MBMS service to any UE yet it triggers a bearer establishment procedure.

Step 8: The SRNC reconfigures the existing RLs in order to be able to handle the additional transmission.

Step11: After the transmission of the concerning MBMS service has started, the UTRAN confirms user specific activation to the CN.

Assumption 4.3: *Similarly to assumption 4.2, we assume that the UTRAN will accept the user activation independantly of the location of the UE, i.e. even if the UE is in an area where it will not receive the MBMS service, still the activation can be completed succesfully.*

4.2.2 MBMS Variable Transmission Mode - PTM example

It has been observed to be a problem how to arrange a bearer establishment on Iu when the CN does not know to which RNC the bearer needs to be established. A solution is to indicate the MBMS activation to the SRNC and have the UTRAN initiate the bearer establishment over Iu.

Figure 6 shows a second example of the variable transmission mode.

Remarks on the different steps:

Step 4: Before establishing the user plane over Iu, the SRNC first checks if the CRNC wants to provide the MBMS-service based on a PTM transmission. This is the case in this example.

Step 5: Since the CRNC does not provide the requested MBMS service to any UE yet it triggers a bearer establishment procedure.

Step 9: After the transmission of the concerning MBMS service has started, the UTRAN confirms user specific activation to the CN.

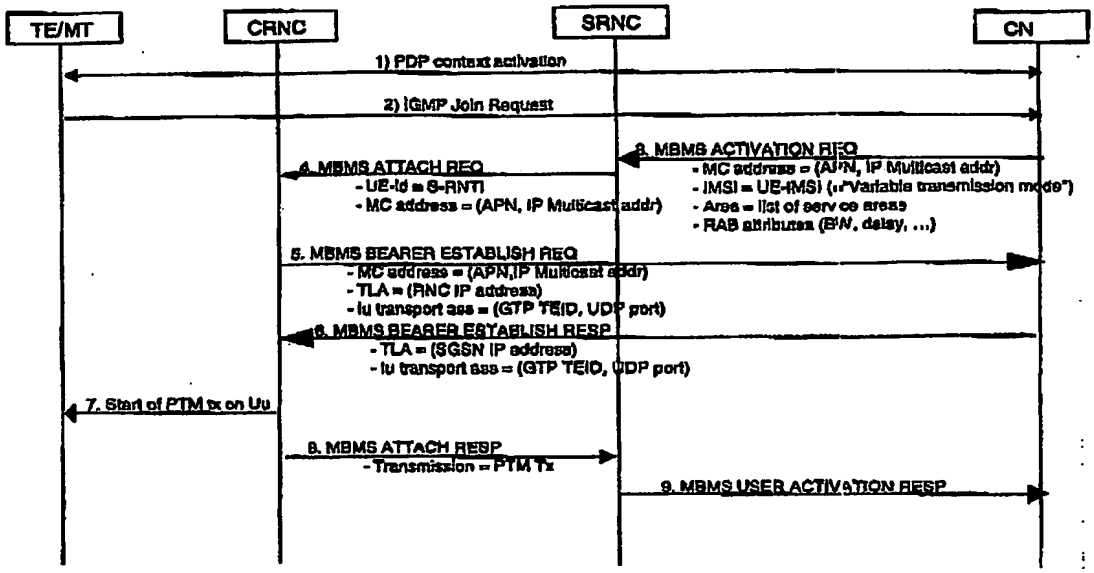

Figure 6: Variable Transmission Mode Activation PTM example

4.3 Mobility scenarios

As a result of the above there will be areas (cells) in which a UE is required to have an RRC connection when receiving MBMS information (PTP or PTM transmission corresponding to transmission alternative 3&4) and areas where such an RRC connection is not required (PTM transmission corresponding to transmission alternative 2). Then the question arises what happens in case of UE mobility between 2 cells where this requirement is different for the 2 cells. The different cases are listed in the table below:

Coming from\going to	PTM RRC connection not required	PTM RRC connection required	PTP (RRC connection required)
PTM RRC connection not required	4.3.1	4.3.3	4.3.8
PTM RRC connection required	4.3.2	4.3.4	4.3.7
PTP (RRC connection required)	4.3.5	4.3.6	4.3.9

Table 4.1.: Mobility overview

Table 4.1 indicates in which section that specific case is discussed.

It is a problem how to switch between two cells which use a different Uu transmission alternative. Mainly two solutions are identified: Either the UTRAN or the UE is responsible for detecting PTM transmissions in a cell where the UE moves. The proposed solution is a mixture: In Idle/PCH/FACH states, the UE has to detect the transmissions on its own. In CELL_DCH state, it will be guided by the UTRAN.

4.3.1 PTM RRC Connection not required -> PTM RRC Connection not required

The UE shall read the new broadcast information and tune to the correct FACH. No UTRAN involvement is required.

4.3.2 PTM RRC Connection required -> PTM RRC Connection not required

Whenever the UE has the RRC connection established for other reasons than only the MBMS service reception, e.g. for a speech call, the RRC connection will remain as normal.

The interesting case is what happens when the UE only has the RRC connection for enabling the reception of the MBMS service. In this case no RB will have been established towards the UE (although a RAB exists), and only the SRBs will be configured. Figure 7 shows a possible signalling flow for this case:

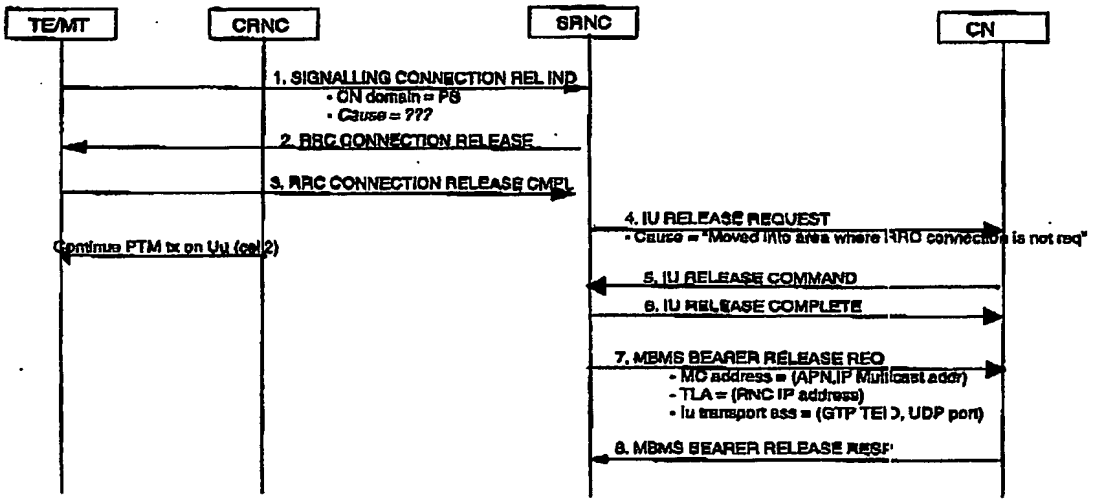

Figure 7: Mobility: RRC connection no longer required

Remarks on the different steps:

Step 1: Since the UE only has a signalling connection (and RRC connection), the only thing that can be released is the signalling connection. The SIGNALLING CONNECTION RELEASE INDICATION is currently only assumed to be needed for rare error cases (e.g. MSC restart with loss of UE context) but could probably be used in this case. It might be preferabe to add a cause IE.

Step 2: Since the UE moves to RRC Idle mode, the SRNC role no longer needs to be fulfilled for this UE. Therefore the IU connection for this UE can be removed.

Step 4: Note that as a result of this step, an SGSN might get data from a GGSN but does not have to deliver it to any RNC.

Step 7: If the SRNC no longer needs the corresponding bearer, a bearer release will be requested. Note that the CRNC is ofcourse still receiving the data.

4.3.3 PTM RRC Connection not required -> PTM RRC Connection required

In this case, a UE receiving the MBMS service in RRC Idle mode now detects that an RRC connection is required. This is shown in the following figure 8 which assumes that although PTM transmission is already ongoing in the cell to which the UE is moving, still the UE is required to establish an RRC connection:

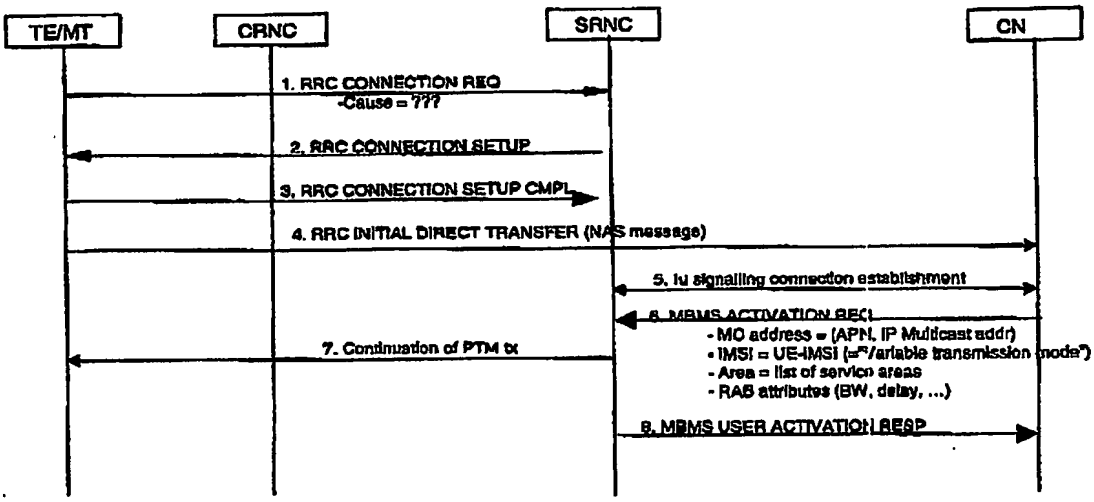

Figure 8: Mobility: RRC connection again required

Remarks on the different steps:

Step 1: The UE will initiate RRC Connection establishment. A new cause value might be required.

Step 4: At this stage, the UE will need to contact the CN somehow to trigger the UE-specific MBMS activation. One option would be to use a normal RAU for this.

It is for further study whether an RA-update is enough for this case (seems quite limiting to mandate a RA-boundary at this place), or if a service request should be mandated. The UE might even sent a service request if it has sent an RA-update. It might be a possibility that this NAS message indicates per MBMS service if an MBMS ACTIVATION REQ is needed or not, or the CN performs an activation for all MBMS services ongoing towards this UE ?

4.3.4 PTM RRC Connection required -> PTM RRC Connection required

4.3.5 PTP RRC Connection required -> PTM RRC Connection not required

In this case, the UE moves from a cell in which it has a PTP connection to a cell in which the MBMS service is broadcasted and no RRC connection is required.

The first question to be considered is who (SRNC or UE) should detect that the RRC connection is no longer required.

SRNC-detection:
If it is the SRNC, the SRNC will find it out by doing the attach to the DRNC, and the DRNC telling the SRNC that it is already providing the service with a PTM to the UE and that no RRC connection is required. Then the SRNC can tell the UE that it should start to receive the MBMS service via the PTM transmission and release the PTP RAB and possibly the RRC connection.

UE-detection:
We assume that the UE will monitor the MBMS SIB even in CELL_DCH state. The UE detects that the RRC connection is no longer required for this service, and triggers the release of the RRC connection.

These alternatives imply the following advantages and disadvantages:

UE detection:
+ simple for the UTRAN
- additional capabilities for UE receiver (reception of broadcast in CELL_DCH state)

SRNC detection:
+ Simpler from a UE point of view
- SRNC needs to be MBMS service aware (not Iu Fixed mode only)

Assumption 4.5: *Here, it is assumed that we go for the SRNC detection option in order to avoid the UE complexity.*

This assumption also impacts the scenario of a UE with a speech call moving inbetween cells where the MBMS service is transmitted with PTM transmission. It is for further study whether the UE detects the PTM transmission or whether the SRNC tells the UE about it.

4.3.6 PTP RRC Connection required -> PTM RRC Connection required

Should be based on an RRC Reconfiguration under control of UTRAN.

4.3.7 PTM RRC Connection required -> PTP RRC Connection required

Should be based on RRC Reconfiguration under control of UTRAN.

4.3.8 PTM RRC Connection not required -> PTP RRC Connection required

Similar to 4.3.3, but with establishing a dedicated channel.

4.3.9 PTP RRC Connection required -> PTP RRC Connection required

This is almost the normal R99 mobility handling in CELL_DCH state, the only difference being the DRNC informing the SRNC that it does not want to provide the MBMS service on ptm.

4.4 Switching between PTP and PTM transmission in one cell

4.4.1 PTP->PTM transmission

4.4.2 PTP->PTM transmission

4.5 Other Issues

4.5.1 Start/Stop of transmission

S2-023325 indicated procedures by which the CN could inform the UTRAN about the start or stopping of transmission. It seems clear that this signalling will exist between BMSC, GGSN and SGSN. It is supposed to trigger a release of the user plane resource while still keeping the MBMS contexts in the network so that an easy later continuation of the service is possible.

Such procedures could be introduced on Iu now or could be seen as potential optimisations for later releases.

If these procedures do not exist, the transmission stop would be mapped to a normal MBMS Deactivation procedure, the transmission start to a MBMS Activation procedure.

Note that the start/stop transmission coming from the BMSC is not UE specific. It will always concern all UEs receiving this MBMS service.

4.5.2 MBMS specific paging over Iu

Currently it is assumed that the CN never has to perform paging for UEs in order to have them receive MBMS related data:

1) In the fixed transmission mode, there is no UE specific signalling.

2) In the variable transmission mode, the paging is UE specific and using existing mechanism/identity.

Note: Of course the UTRAN might have to page the UE/UEs in order to have it/them receive MBMS related information.

5 Product Phasing

It is expected that the functionality described in the previous chapters will not be introduced all at once. Instead there will be a phased introduction. This chapter describes different possible MBMS implementation options[4].

5.1 MBMS implementation options

The following possible MBMS implementation options are discerned:

[4] Only the implementation options which are considered most sensible are described.

5.1.1 No MBMS support in UTRAN

In this step, the UTRAN is not aware of any MBMS specific functionality; a standard R99 UTRAN can be used. MBMS services are provided based on normal PTP RAB's.

Benefits:
+ No UTRAN adaptations

Drawbacks:
- Only PTP support
- Only reception in RRC connected mode.

5.1.2 MBMS Fixed transmission mode

In this step, only CRNC's are upgraded with MBMS functionality. They provide the MBMS service with a fixed PTM transmission (MBMS fixed transmission mode). In addition, MBMS services with an expected low number of interested UE's can be handled with PTP transmission (based on 5.1.1 option).

Benefits:
+ Limited UTRAN impact
+ SRNC does not need to be MBMS aware
+ PTM for MBMS services with expected high number of receiving UEs
+ PTP for MBMS services with expected low number of receiving UEs
+ Support of reception in RRC idle mode in PTM areas

Drawbacks:
- One MBMS service always PTP or always PTM
- CN needs to estimate the expected average number of receiving UEs in case both PTP and PTM are used.

5.1.3 MBMS Variable transmission mode: (dis)continuous PTM in configured areas

In this step, all UTRAN RNC's are upgraded to become MBMS aware. MBMS services are provided based on PTM, but the transmission can be turned on/off based on number of receiving UEs.

Benefits:
+ No unnecessary PTM transmission if no interested UE is present.
+ Support of reception in RRC idle mode in PTM areas with continuous PTM transmission.

Drawbacks:
- All UTRAN RNCs (SRNCs and CRNCs) need to become MBMS aware
- Only PTM support

5.1.4 MBMS Variable transmission mode: PTP + continuous PTM in configured areas

In this step, all UTRAN RNC's are upgraded to become MBMS aware. An MBMS service can be provided based on PTP and/or PTM transmission. The PTM transmission is continuous in configured PTM areas.

Benefits:
+ One MBMS services provided by either PTP or PTM in one cell based on expected number of UEs in that cell
+ Support of reception in RRC idle mode in PTM areas with continuous PTM transmission

Drawbacks:
- All UTRAN RNCs (SRNCs and CRNCs) need to become MBMS aware
- No switching between PTP and PTM in one cell

5.1.5 MBMS Variable transmission mode: full support

In this step, all UTRAN RNC's are upgraded to become MBMS aware. MBMS services can use all 3 transmission alternatives mentioned in chapter 3.

Benefits:
+ Most advanced solution with respect to radio efficiency
+ Support of reception in RRC idle mode in PTM areas with continuous PTM transmission

Drawbacks:
- Most complex solution

5.1.6 Overview

An overview on the main differences between the implementation options is shown in the following table:

		Supported Uu Transmission alternatives	PTP or PTM transmission in cells	PTM on/off switching in one cell	PTP/PTM switching in one cell
1	No MBMS Support in UTRAN	1	PTP	N.A.	N.A.
2	MBMS Fixed transmission mode	1,2	All cells PTP or All cells PTM[5]	No	No
3	MBMS Variable transmission mode: (dis)continuous PTM in configured areas	2,3	PTM	Yes	N.A.
4	MBMS Variable transmission mode: PTP + continuous PTM in configured areas	2,4	PTP or PTM	No	No
5	MBMS Variable transmission mode: full support	2,3,4	PTP or PTM	Yes	Yes

Table 5.1: Implentation option overview

The table indicates which characteristics the UTRAN will have in a certain implementation option with respect to the handling of one MBMS service.

[5] The current assumption is that it will not be possible to have PTP<->PTM switching in the mobility case with this implementation solution (so e.g. going from a cell with PTP transmission to another cell with PTM transmission). However this issue is still under investigation as part of assumption 4.5.

6 Uu aspects

6.1 Requirements

1) Whenever there is a PTM transmission for a certain MBMS service X ongoing in a cell, a UE shall be able to detect this transmission and receive it. This both in RRC Idle mode and RRC Connected Mode. Reception may depend on UE capabilities.

2) Whenever there is a PTM transmission for a certain MBMS service X ongoing in a cell, a UE shall be able to determine if it is required to establish an RRC connection in order to ensure the PTM transmission, or if no RRC connection is required (RRC Idle mode supported).

Assumption 5.1: *It is assumed that in case no PTM transmission for a certain MBMS service X is ongoing, it is not required to enable the UE to distinguish between a cell in which the MBMS service X information can be provided or a cell in which the MBMS service X cannot be provided.*

6.2 Solution description

At least three different steps can be discerned in the MBMS related information that needs to be sent over the Uu:

1) Broadcast of configuration information regarding ongoing PTM MBMS data transmission

2) Paging of UEs in case of actual data transfer

3) Actual MBMS data transfer

These three steps are described in more detail below.

6.2.1 MBMS configuration broadcast

A new "MBMS SIB" should probably be defined for this purpose. The MBMS SIB would contain for each MBMS service broadcasted in the cell the following information:

- IP MC address
- Physical channel (S-CCPCH) related information
- Transport channel (FACH) related information (FFS)
- Logical channel related information (FFS)
- MC-RNTI (FFS)

In general, this information should not be changed too frequent since SIB updating requires sending notifications to all UEs.

6.2.2 Paging of UEs in case of actual data transfer

In a UE-power-efficient solution, UEs should not be mandated to have to monitor the concerning FACH channel continuously if no transmission is ongoing for the concerning MBMS service.

Several ways exist to overcome such a problem in UTRAN:

1) Use of a fixed DTX scheme: Every MBMS service could only be allowed to start transmission at certain frame positions. A UE receiving this MBMS service would only have to start listening at these instances. If nothing is received in the concerning radio frame, the UE can go to sleep again untill the next possible scheduling occasion.

2) Use of paging: Inform the UE when to listen to the FACH channel by means of paging. The MBMS paging should be specific to a specific MBMS service. The following alternatives for making the current UE-specific paging suitable for MBMS paging are identified:

   1) Allocation of a RNTI per MBMS service

   2) Usage of the 12 remaining bits on the PICH channel

These alternatives need to be investigated in more detail.

6.2.3 Actual data transfer

The actual data transfer is assume to be transported over the FACH channel and will be using a special MC-RNTI.

How many and which logical channel will be used is still FFS, but e.g. as for CBS, a CTCH logical channel could be used.

7 Iu aspects

7.1 Requirements

Based on the above, it should be clear that when the CN wants to provide a certain MBMS service, it has to configure the UTRAN with information regarding in which service areas this MBMS service should be provided with a fixed transmission mode, and in which service areas the MBMS service can be provided with a variable transmission mode. This configuration phase of the UTRAN for a specific MBMS service will be UE independent.